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IS 4171 (1983): Copper rods and bars for general engineering purposes [MTD 8: Copper and Copper Alloys]

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“Knowledge is such a treasure which cannot be stolen”





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IS : 4171 - 1983  
REAFFIRMED

*Indian Standard*

1996

SPECIFICATION FOR  
COPPER RODS AND BARS FOR  
GENERAL ENGINEERING PURPOSES

(First Revision)

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BUREAU OF INDIAN STANDARDS  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
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Gr 2

January 1984

AMENDMENT NO. 1 JUNE 2004  
TO  
IS 4171 : 1983 SPECIFICATION FOR  
COPPER RODS AND BARS FOR GENERAL  
ENGINEERING PURPOSES

( *First Revision* )

( *Page 4, clause 2.1, line 2* ) — Substitute 'IS 1387 : 1993†' for 'IS : 1387 - 1967†'.

( *Page 4, footnote marked '†'* ) — Substitute the following for the existing footnote:

†General requirements for the supply of metallurgical materials (second revision).'

( *Page 4, clause 3.0, line 2* ) — Substitute 'IS 3288 ( Part 3 ) : 1986‡' for 'IS : 3288 ( Part 1 ) - 1981‡'.

( *Page 4, footnote marked '‡'* ) — Substitute the following for the existing footnote:

‡Glossary of terms relating to copper and copper alloys : Part 3 Wrought forms.'

( *Page 4, clause 5.1, line 2* ) — Substitute 'IS 1608 : 1995||' for 'IS : 2654 - 1977||'.

( *Page 4, footnote marked '||'* ) — Substitute the following for the existing footnote:

|| Mechanical testing of metals — Tensile testing (second revision).'

( *Page 5, clause 7.1, line 2* ) — Substitute 'IS 2826 : 1986\*' for 'IS : 2826 - 1980\*'.

( *Page 5, footnote marked '\*'* ) — Substitute the following for the existing footnote:

\*Dimensions and tolerances for copper and copper alloys, rods and bars for general engineering purposes (third revision).'

( *Page 5, clause 7.2, line 2* ) — Substitute 'IS 2826 : 1986\*' for 'IS : 2826 - 1980\*'.

**Amend No. 1 to IS 4171 : 1983**

( *Page 5, footnote marked '\*'*  ) — Substitute the following for the existing footnote:

*'\*Dimensions and tolerances for copper and copper alloys, rods and bars for general engineering purposes (third revision).'*

( MTD 8 )

*Indian Standard*

**SPECIFICATION FOR  
COPPER RODS AND BARS FOR  
GENERAL ENGINEERING PURPOSES**

**(First Revision)**

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*Indian Standard*

**SPECIFICATION FOR  
COPPER RODS AND BARS FOR  
GENERAL ENGINEERING PURPOSES**

*(First Revision)*

**0. FOREWORD**

**0.1** This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 28 October 1983, after the draft finalized by the Copper and Copper Alloys Sectional Committee had been approved by the Structural and Metals Division Council.

**0.2** The rods and bars conforming to this standard are generally used in the manufacture of rivets, screws, bolts, hooks, fasteners, buckles, springs and machine components.

**0.3** This standard was first published in 1967. As a result of experience gained during the years, the Sectional Committee decided to revise this standard. In this revision, the following modifications have been made:

- a) MKS units have been changed to SI units for all quantity and dimensions;
- b) Chemical composition and tensile properties have been modified;
- c) Clauses for terminology, chemical composition and sampling and criteria for conformity have been modified; and
- d) Hammering or crushing down test and bend test have been deleted.

**0.4** This standard contains clauses **5.2, 5.2.1, 6.2, 7.3, 9.1** and **11.1** where the purchaser is allowed to exercise his option and which calls for an agreement between the purchaser and the manufacturer.

**0.5** In preparation of this standard, the Sectional Committee kept in view the manufacturing and trade practices followed in the country in this field.

**0.6** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in

accordance with IS : 2-1960\*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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## 1. SCOPE

1.1 This standard covers the requirements of copper rods and bars for general engineering purposes.

## 2. SUPPLY OF MATERIAL

2.1 General requirements relating to the supply of material shall conform to IS : 1387-1967†.

## 3. TERMINOLOGY

3.0 For the purpose of this standard the following definition as given in IS : 3288 ( Part 1 )-1981‡ shall apply.

3.1 **Bar/Rod** — Any extruded, drawn, cold or hot rolled, forged, cast or combination of any of these processes of solid section supplied in straight length, whose width or greatest distance between parallel faces is greater than 6 mm.

## 4. CHEMICAL COMPOSITION

4.1 The material shall have the chemical composition given in Table 1.

4.2 The chemical composition shall be determined either by the method specified in IS : 440-1964§ or any other established instrumental/chemical method. In case of dispute the procedure specified in the latest edition of IS : 440§ for chemical analysis, shall be the referee method.

## 5. MECHANICAL PROPERTIES

5.1 **Tensile Properties** — The material when tested in accordance with IS : 2654-1977|| shall have the tensile properties as given below:

| Condition       | Tensile Strength<br>( MPa ) | Elongation Percent on<br>Gauge Length $5.65\sqrt{A}$ |
|-----------------|-----------------------------|--|
| Annealed        | 260 Max                     | 33 Min   |
| As manufactured | 230 Min                     | 13 Min   |

\*Rules for rounding off numerical values ( revised ).

†General requirements for the supply of metallurgical materials ( first revision ).

‡Glossary of terms for copper and copper alloys : Part 1 Cast form and wrought form ( main types ) ( second revision ).

§Methods of chemical analysis of copper ( revised ).

||Method for tensile testing of copper and copper alloys ( first revision ).

TABLE 1 CHEMICAL COMPOSITION  
( Clause 4.1 )

| SL No. | CONSTITUENTS   | PERCENT    |
|--------|--|------------|
| (1)    | (2)  | (3)        |
| i)     | Copper, including silver, <i>Min</i>                                     | 99.5       |
| ii)    | Tin, <i>Max</i>  | 0.01       |
| iii)   | Lead, <i>Max</i>   | 0.01       |
| iv)    | Iron, <i>Max</i>   | 0.030      |
| v)     | Nickel, <i>Max</i>   | 0.10       |
| vi)    | Arsenic, <i>Max</i>  | 0.05       |
| vii)   | Antimony, <i>Max</i>   | 0.0050     |
| viii)  | Bismuth, <i>Max</i>  | 0.0030     |
| ix)    | Phosphorus   | 0.015-0.06 |
| x)     | Selenium and tellurium, <i>Max</i>                                       | 0.02       |
| xi)    | Total impurities ( excluding silver, nickel and phosphorus ), <i>Max</i> | 0.06       |

**5.2 Hydrogen Embrittlement Test** — When required by the purchaser, test pieces shall be tested in accordance with the method given in Appendix A.

**5.2.1** The number of samples to be tested for this test shall be as agreed to between the purchaser and the manufacturer.

## 6. FREEDOM FROM DEFECTS

**6.1** The rods/bars shall be clean, smooth and free from fins, spills, porosity, cracks or other defects and shall be reasonably straight and free from twists.

**6.2 Finish** — The rods/bars shall be finished by such cold working and annealing operations as would produce the required temper, corner, edge and surface finish as agreed to between the purchaser and the manufacturer.

## 7. DIMENSIONS AND TOLERANCES

**7.1 Sizes** — The material shall be supplied in sizes as specified in IS : 2826-1980\*.

**7.2 Tolerance** — The tolerance for rods/bars shall be as given in IS : 2826-1980\*.

\*Dimensions for wrought copper and copper alloy rod and bar for general engineering purposes ( second revision ).

**7.3 Radius on Edges ( Square and Polygonal Material )** — If the material is required in the radiused edge, the radius of curvature shall be as agreed to between the purchaser and the manufacturer.

## **8. PACKING**

**8.1** The rods/bars shall be supplied in bundles and strapped with hoops, and shall be suitably packed to avoid damage during transit or as required by the purchaser.

## **9. MARKING**

**9.1** Suitable metallic tags/labels with markings made on them to show the size of rod/bar, grade, mass, lot number, date of manufacture, temper of the material in addition to name of the manufacturer, and any such information required by the purchaser, shall be attached to each bundle of the material.

**9.1.1** The bundles of rods/bars may also be marked with the Standard Mark.

**NOTE** — The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

## **10. SAMPLING AND CRITERIA FOR CONFORMITY**

**10.1** The method of drawing representative samples of the material and the criteria for conformity shall be as prescribed in Appendix B.

## **11. INFORMATION TO BE GIVEN BY THE PURCHASER**

**11.1** The following information shall be given by the purchaser while ordering the material:

- a) Whether hydrogen embrittlement test required ( *see 5.2* ),
- b) Condition of finish ( *see 6.2* ),
- c) If the material required in radiused edges ( *see 7.3* ),
- d) Marking details ( *see 9* ), and
- e) Sampling and criteria for conformity ( *see 10* ).

## A P P E N D I X A

( *Clause 5.2* )

### HYDROGEN EMBRITTLEMENT TEST

#### A-1. TEST PIECES

**A-1.1** Test pieces of suitable length shall be made from rods/bars selected as specified in 5.2. Rods/bars up to 10 mm diameter may be tested in full size. From larger size rods, test pieces up to 10 mm shall be turned eccentrically from the rod/bar so that the test pieces included the skin at one side.

**A-1.2** Test samples shall be exposed to an atmosphere of hydrogen for a period of about 20 minutes at a temperature 800 to 875°C after which they shall be cooled. Each test piece is then bent steadily at right angles and flattened close. There shall be no sign of cracks or flaws on the pieces so tested.

## A P P E N D I X B

( *Clause 10.1* )

### SAMPLING AND CRITERIA FOR CONFORMITY

**B-1.** Unless otherwise agreed to between the purchaser and the supplier the following sampling procedures and criteria for conformity shall hold good.

**B-1.1 Lot** — In any consignment, all the rods/bars of the same grade, size, temper and manufactured by a single firm under essentially similar conditions of production shall be grouped to constitute a lot. The lot size shall not exceed the quantity given in Table 2. Accordingly, one or more lots may be formed from a consignment depending on the mass, size, grade, etc, of the material.

**B-1.2** From each bundle, 10 rods/bars shall be selected at random and be examined for visual and dimensional requirements. A rod/bar which fails in one or more of the requirements shall be termed as 'defective'. From the samples examined in each bundle not more than one defective shall be permitted. If this is exceeded, all the material in the bundle shall be subjected to visual and dimensional inspection.

**B-1.3** Tests for chemical composition shall be conducted at the rate of one test per 500 kg or part thereof from the material in the lot.

**NOTE** — The material required for chemical analysis from the selected rod/bar shall be taken in accordance with IS : 1817-1961\*.

**B-1.3.1** If the test results as obtained for each of the chemical constituents satisfy the corresponding requirements under 4, the lot shall be considered as conforming to the chemical requirements of this specification.

**B-1.3.2** If the test results of the chemical analysis fail to satisfy the requirements for any of the constituents two more tests for that constituent shall be done on the same sample in order to confirm that the analysis has been done properly. If both of the test results satisfy the relevant requirements under 4, the lot shall be considered as conforming to the specification, otherwise not.

**B-1.4** The number of tests to be conducted for each of the mechanical properties requirements shall be according to Table 2. For this purpose the number of bundles to be selected shall be equal to the number of tests to be performed and from each bundle one test shall be taken for mechanical tests.

**TABLE 2 LOT SIZE AND NUMBER OF TESTS FOR MECHANICAL PROPERTIES REQUIREMENTS**

| SL<br>No. | CROSS-SECTIONAL<br>DIMENSION |                        | MAXIMUM LOT<br>SIZE | No. OF TESTS FOR<br>MECHANICAL PROPERTIES<br>REQUIREMENT |
|-----------|------------------------------|------------------------|---------------------|--|
|           | Over                         | Up to and<br>Including |                     |  |
| (1)       | (2)                          | (3)                    | (4)                 | (5)  |
|           | mm                           | mm                     | kg                  |  |
| i)        | 6                            | 12                     | 2 000               | One per every 250 kg<br>or part thereof                  |
| ii)       | 12                           | 40                     | 2 000               | One per every 500 kg<br>or part thereof                  |
| iii)      | 40                           | 80                     | 4 000               | One per every 1 000 kg<br>or part thereof                |
| iv)       | 80                           | —                      | 4 000               | One per every 2 000 kg<br>or part thereof                |

**B-1.4.1** The lot shall be considered as conforming to the requirements of the mechanical properties if all the results of mechanical tests on different samples satisfy the corresponding requirements.

**B-1.4.2** If the test results on any sample for mechanical tests fail to satisfy the requirements for any of the mechanical properties, two more tests shall be done. If both the retest sample pass in all the requirements of mechanical tests the lot shall be considered as conforming to the specification, otherwise not.

\*Methods of sampling non-ferrous metals for chemical analysis.

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